

Short Report

Squatting facets on the neck of the talus and extensions of the trochlear surface of the talus in late Byzantine males

I. H. OYGUCU¹, M. A. KURT^{1,2}, I. IKIZ¹, T. EREM¹ AND D. C. DAVIES²

¹ *Department of Anatomy, School of Medicine, University of Uludag, Bursa, Turkey and* ² *Department of Anatomy and Developmental Biology, St George's Hospital Medical School, London, UK*

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ABSTRACT

Remodelling of bone occurs in response to physical stress. Habitual squatting is associated with modifications of the neck of the talus (squatting facets) and its trochlear/malleolar surfaces (trochlear extensions), and individual populations exhibit different incidences of these modifications that reflect their lifestyle. The occurrence of talar modifications was therefore investigated in a population of late Byzantine (13th century AD) adult male skeletons. Lateral squatting facets occurred most frequently (37.7%), but medial (0.6%), combined (0.6%) and continuous (gutter-like) facets (0.6%) were also observed. Lateral (8.0%), medial (10.9%) and continuous (lateral/central/medial) extensions (4.6%) of the trochlear surface were all present in the late Byzantine population. There was no evidence of side dimorphism. The occurrence of lateral squatting facets in the late Byzantine population was greater than that reported for modern Europeans, but similar to that reported for some populations of modern Indians. The frequency of occurrence of trochlear extensions in the late Byzantine population was substantially less than in modern Indian populations, but similar to modern Europeans. Therefore, it is unlikely that precisely the same factors determine the expression of squatting facets and trochlear extensions.

Key words: Hyperdorsiflexion of the foot; bone remodelling.

INTRODUCTION

The articular morphology of the human skeleton can be subject to modification by stresses imposed upon it. Habitual squatting has long been recognised to alter the skeletal morphology of the lower limb (Thomson, 1889, 1890). Squatting is a resting postural complex that involves hyperflexion at the hip and knee and hyperdorsiflexion at the ankle and subtalar joints. During locomotion, the foot is rarely dorsiflexed sufficiently to bring the anterior border of the inferior extremity of the tibia into contact with the dorsum of the neck of the talus. Thus modifications of the neck of the talus and the distal tibia indicating their habitual contact have been taken as evidence of the extreme dorsiflexion of the ankle that occurs in squatting (Thomson, 1889, 1890; Charles, 1893;

Aitken, 1905; Sewell, 1905; Wood, 1920; Barnett, 1954; Das, 1959; Singh, 1959; Rao, 1966; Satinoff, 1972; Pandey & Singh, 1990). A number of types of true squatting facets can be found on the neck of the talus (Barnett, 1954; Pandey & Singh, 1990). In addition, anterior extensions of the trochlear and malleolar surfaces of the talus that are continuous with the normal surfaces may be present. Since these extensions are not associated with modifications of the anterior margin of the distal tibia (Barnett, 1954), they may be products of dorsiflexion at the ankle joint other than that of squatting. It has been suggested (Charles, 1894; Wood Jones, 1949) that the presence of squatting facets on the dorsal surface of the neck of the talus in the fetus, as well as in adults of Oriental races, provides evidence for the inheritance of acquired characters. However, squatting facets are

also present in European fetuses (Sewell, 1905; Barnett, 1954) and these facets are more prevalent in European fetuses than in adults (Barnett, 1954). Since Singh (1959) provided evidence that the Indian fetus inherits no greater expression of squatting facets than the European fetus, the fetal presence of such facets appears likely to result from the considerable dorsiflexion of the foot that occurs during intrauterine life. The persistence and development of squatting facets in the adult therefore results from remodelling due to stresses placed on the bone in life, and their presence postmortem provides information about previous lifestyle. With this in mind, the occurrence of modifications of the head and neck of the talus was investigated in a series of late Byzantine male skeletons.

MATERIALS AND METHODS

A total of 175 tali (85 right, 90 left) without apparent pathology or physical damage was investigated. They were derived from adult male skeletons (sexed by pelvic and cranial morphology) with healthy teeth, excavated from a late Byzantine (13th century A.D.) burial site near Iznik (Nicea), Turkey. The mean age of the skeletons at death was calculated (by M. Özbek) to be approximately 35 y, using the morphology of the symphyseal surface of the pubis and the degree of closure of the cranial sutures (Vandervael,

1964). The individuals are thought to have died as a result of battle, since many showed evidence of traumatic injury shortly before death (see Özbek, 1984) and they were buried in some disarray. The occurrence of squatting facets on the neck of the talus and extensions of the trochlear surface of the talus (see Fig. 1) was determined following the classification of Pandey & Singh (1990). Trochlear extensions were defined as prolongations of the trochlear surface anterior to a line drawn across the head of the talus perpendicular to the long axis of the foot, from the superoanterior margin of the lateral malleolar surface to the medial malleolar surface.

RESULTS

Squatting facets

A lateral squatting facet occurs on the dorsum of the neck of the talus and is usually continuous with the lateral trochlear surface (Fig. 1*A*). However, the concavity of the facet changes abruptly to the convexity of the trochlear surface. Such a facet was present on 66 (29 right and 37 left) tali (Table 1) and occurred in conjunction with a medial trochlear extension (see below and Fig. 2) on 9 tali. A medial squatting facet is found on the dorsomedial aspect of the neck of the talus, that is not continuous with the trochlear surface (Fig. 1*B*). This type of facet was

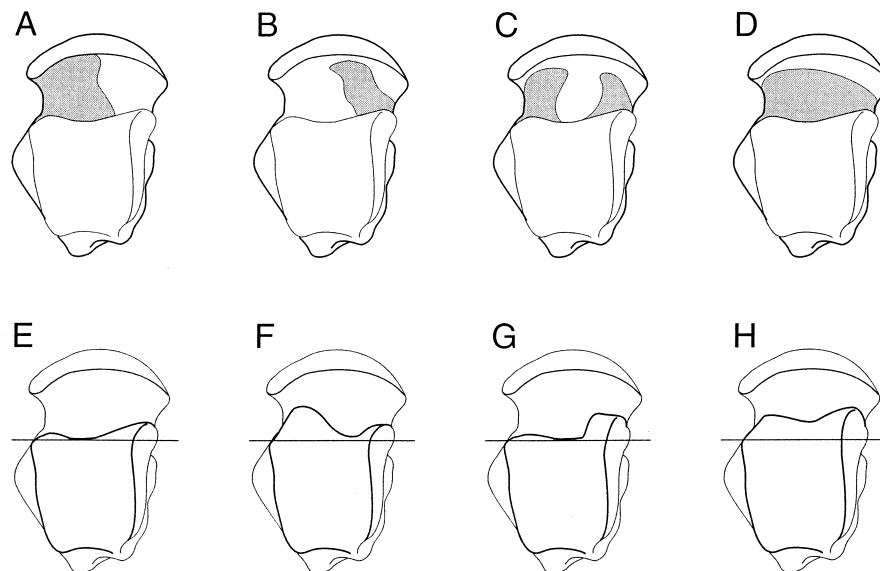


Fig. 1. Diagrams of the dorsal aspect of a left talus illustrating the 4 types of squatting facet (shaded areas) on the neck of the talus: *A*, lateral; *B*, medial; *C*, combined (lateral + medial); *D*, continuous (gutter-like). *E* illustrates a 'normal' talus without squatting facets or trochlear extensions and the remainder illustrate the 3 types of trochlear extension: *F*, lateral; *G*, medial; *H*, continuous (lateral/central/medial). Trochlear extensions were defined as prolongations of the trochlear surface anterior to the line (illustrated) drawn across the head of the talus perpendicular to the long axis of the foot, from the superoanterior margin of the lateral malleolar surface to the medial malleolar surface.

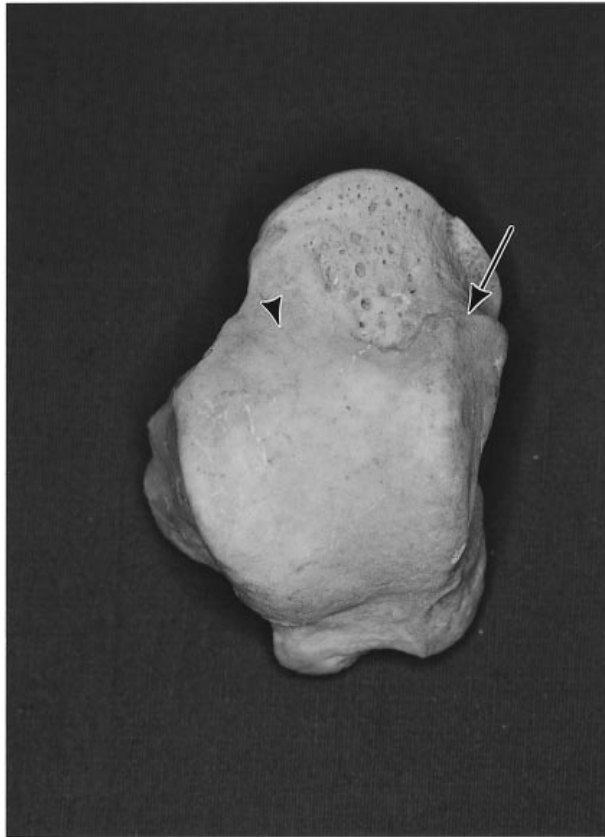


Fig. 2. Photograph of the dorsal aspect of a left talus from a late Byzantine (13th century A.D.) adult male skeleton excavated from a burial site near Iznik (Nicaea), exhibiting a lateral squatting facet (overlain by arrowhead) together with a medial trochlear extension (arrow pointing to its anterior border)

Table 1. Incidence of squatting facets and trochlear extensions on the tali

No. of tali	Right 85	Left 90	Total 175
<i>Squatting facets</i>			
Lateral	29 (34.1 %)	37 (41.1 %)	66 (37.7 %)
Medial	1 (1.2 %)	—	1 (0.6 %)
Combined (lateral + medial)	—	1 (1.1 %)	1 (0.6 %)
Continuous (gutter-like)	—	1 (1.1 %)	1 (0.6 %)
<i>Trochlear extensions</i>			
Lateral	10 (11.8 %)	4 (4.4 %)	14 (8.0 %)
Medial	8 (9.4 %)	11 (12.2 %)	19 (10.9 %)
Continuous (lateral/central/medial)	4 (4.7 %)	4 (4.4 %)	8 (4.6 %)
'Normal' (No facets or extensions)	33 (38.8 %)	32 (35.6 %)	65 (37.1 %)

found on only 1 (right) talus (Table 1). A combined squatting facet comprises both lateral and medial facets (Fig. 1C) and was found on only 1 (left) talus

(Table 1). A continuous (gutter-like) facet that occupies the majority of the dorsal surface of the neck (Fig. 1D), was present on 1 (left) talus (Table 1).

Extensions of the trochlear surface of the talus

A lateral extension, that is an extension of approximately the lateral third of the trochlear surface onto the dorsum of the neck of the talus (Fig. 1F), was present on 14 (10 right and 4 left) tali (Table 1). A medial extension is a prolongation of the medial trochlear surface onto the dorsum of the neck of the talus, that is usually associated with extension of its medial articular surface (Fig. 1G). Such an extension occurred on 19 (8 right and 11 left) tali (Table 1). Anterior prolongation of the medial articular surface of the talus in the absence of a medial extension was not observed. A continuous (lateral/central/medial extension) of the trochlear surface onto the dorsal surface of the neck of the talus (Fig. 1H), was present on 8 (4 right and 4 left) tali (Table 1).

DISCUSSION

Although modifications of the talus indicative of habitual squatting have been reported to occur in hominids since at least the Pleistocene era (Trinkaus, 1975), few previous studies have produced data detailed enough to allow accurate comparison of different populations. Of the 175 tali investigated in the current study, 68 were the right and left tali from the same skeletons, i.e. there were 34 complete pairs. Of these, 31 pairs (91.2 %) displayed the same features on both sides and only 3 pairs (8.8 %) exhibited side asymmetry (Table 2). These findings are in accord with the reports by Finnegan (1978) and Panteado et

Table 2. Incidence of similar and dissimilar modifications in tali

	No. of pairs
<i>Same features</i>	
Lateral squatting facets	10
Medial extensions	5
Lateral extensions	1
Medial extensions + lateral squatting facets	3
Normal (no facets or extensions)	12
<i>Different features</i>	
No facets or extensions on the right + lateral squatting facet on the left	1
No facets and extensions on the left + lateral squatting facet on the right	2

Table 3. *Reported incidence of squatting facets and trochlear extensions in different populations*

Population ...	Barnett (1954) European (UK)	Singh (1959) Indian	Das (1959) Indian (Uttar Pradesh)	Pandey and Singh (1990) Indian (E. Uttar Pradesh & N. Bihar)	Current study Late Byzantine
No. of tali ...	100	300	200	262	175
Squatting facets					
Lateral	2 (2.0%)	86 (28.6%)	40.5/41.5%	218 (83.2%)	66 (37.7%)
Medial	0	0	8 (4.0%)	46 (17.6%)	1 (0.6%)
Combined (lat. + med.)	—	—	3.0%	31 (11.8%)	1 (0.6%)
Continuous (gutter-like)	—	—	13%	28 (10.7%)	1 (0.6%)
Trochlear extensions					
Lateral	17 (17%)	73 (24.3%)	49 (24.5%)	238 (90.8%)	14 (8.0%)
Medial	11 (11%)	74 (24.6%)	51 (25.5%)	158 (60.3%)	19 (10.9%)
Continuous (lat./cent./med.)	—	91 (30.3%)	45 (22.5%)	152 (58.0%)	8 (4.6%)

al. (1986) that nonmetric traits of the infracranial skeleton do not show side dimorphism.

The modifications of the talus observed in the current study are consistent with prolonged extreme dorsiflexion of the talus during squatting, an activity compatible with the farming lifestyle of the late Byzantine population in Iznik (Özbek, 1984). Examination of the teeth of these skeletons revealed them to be generally healthy, with few areas of erosion usually limited to the dentine layer and a limited incidence of cavities. Therefore, the population was considered to have eaten more fish/meat and vegetables than carbohydrate rich foods and not to have been malnourished (Özbek, 1984). In the late Byzantine male tali, the lateral squatting facet occurred most frequently (37.7%), compared to the medial (0.6%), combined (0.6%) and continuous (0.6%) facets on the neck of the talus (Table 1). The occurrence of lateral squatting facets in late Byzantine males is greater than that reported for modern Europeans (Barnett, 1954), similar to some populations of modern Indians (Das, 1959; Singh, 1959), but less than others (Pandey & Singh, 1990). Comparative data are given in Table 3. The difference in the occurrence of squatting facets between apparently similar Indian populations may reflect the sex ratios of the bones investigated, as Pandey & Singh (1990) reported that the prevalence of squatting facets is significantly greater in females than in males. Such a sex bias may also affect comparisons between different populations, but it should be noted that the reported increased incidence in females varied only between approximately 9 and 16%, depending on the type of squatting facet (Pandey & Singh, 1990).

The distribution of the 3 types of trochlear extension in late Byzantine males was more balanced than the distribution of squatting facets. Lateral extensions were present in 8.0%, medial extensions in 10.9% and continuous (lateral/central/medial) extensions in 4.6% of the tali (Table 1). The frequency of occurrence of trochlear extensions in late Byzantine males was substantially less than that in modern Indian populations (Singh, 1959; Das, 1959; Pandey & Singh, 1990) but comparable with modern Europeans (Barnett, 1954) (Table 3).

The disjunction in the appearance of squatting facets and trochlear extensions between different populations suggests that their presence is not determined by exactly the same factors. In view of the fact that squatting facets were present almost entirely on the lateral aspect of the neck of the talus, it is possible that the pes valgus deformity was present in the late Byzantine population investigated. The pes valgus deformity can be caused by prolonged standing and walking on a hard surface (which would be consistent with the lifestyle of a late Byzantine farmer) and results in outward deviation of the foot at the talocalcaneal joint (Cotta, 1980), bringing the lateral surface of the neck of the talus into contact with the anterolateral margin of the inferior extremity of the tibia. Thus extreme dorsiflexion might not be the only reason for the modification of the upper surface and neck of the talus.

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